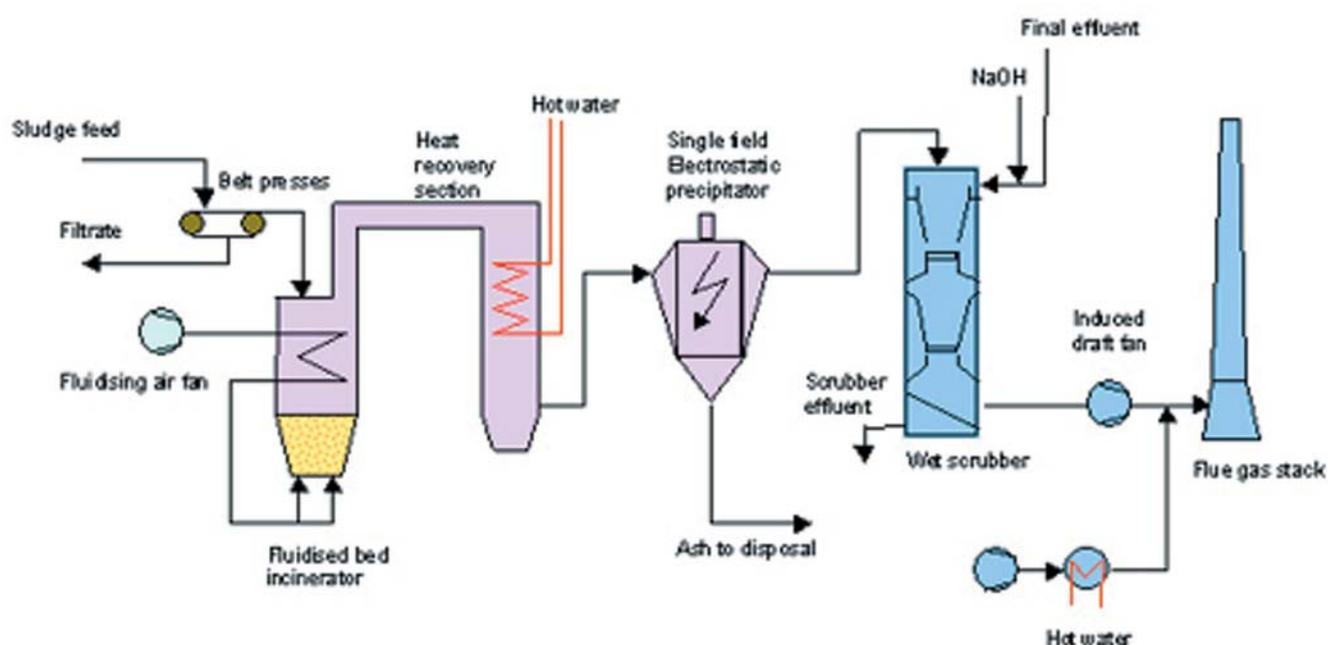


Yorkshire Water's Sewage Sludge Incinerators upgrade at four plants to meet Directive

by

Justin Abbott, Ken Jones, Steve Wright

Yorkshire Water operates four sewage sludge incinerators located at Esholt, Bradford; Blackburn Meadows, Sheffield; Calder Valley, Huddersfield, and Knostrop, Leeds. Each of these facilities will be upgraded in order to meet requirements of the Waste Incineration Directive. Knostrop, constructed in 1997, already complies with many of the WID requirements and the scope of works on this site is substantially less than on the other three sites. Construction on the first sites commenced in December 2003, with the installation and commissioning programme extending through to the end of 2005. The challenge for the whole project team is to deliver a technically complex project across the four sites within the deadline of 28th December 2005 laid down in the WID.



BEFORE UPGRADE

courtesy Yorkshire Water

Flue-Gas treatment (FGT)

In order to meet the emission limits identified in WID it is necessary for the FGT process to be improved at the three older sites. In particular, the new FGT process stream will need to improve sulphur dioxide (SO₂) removal efficiency and mercury removal efficiency. A number of potential process options, which were believed to be capable of achieving the emission targets were considered and evaluated.

These included:

- * modify/replace existing wet scrubber + tertiary fixed bed adsorption stage;
- * modify/replace existing wet scrubber + tertiary recirculating bag filter adsorption stage ;
- * dry scrubbing system (adsorption reactor + bag filter) upstream of the existing scrubber;
- * dry scrubbing system (adsorption reactor + bag filter) downstream of the existing scrubber.

Various options were discussed and evaluated at a series of Value Management workshops and assessed against a series of predetermined criteria covering operability, Opex, Capex and operating experience. Following this, the decision was taken to go

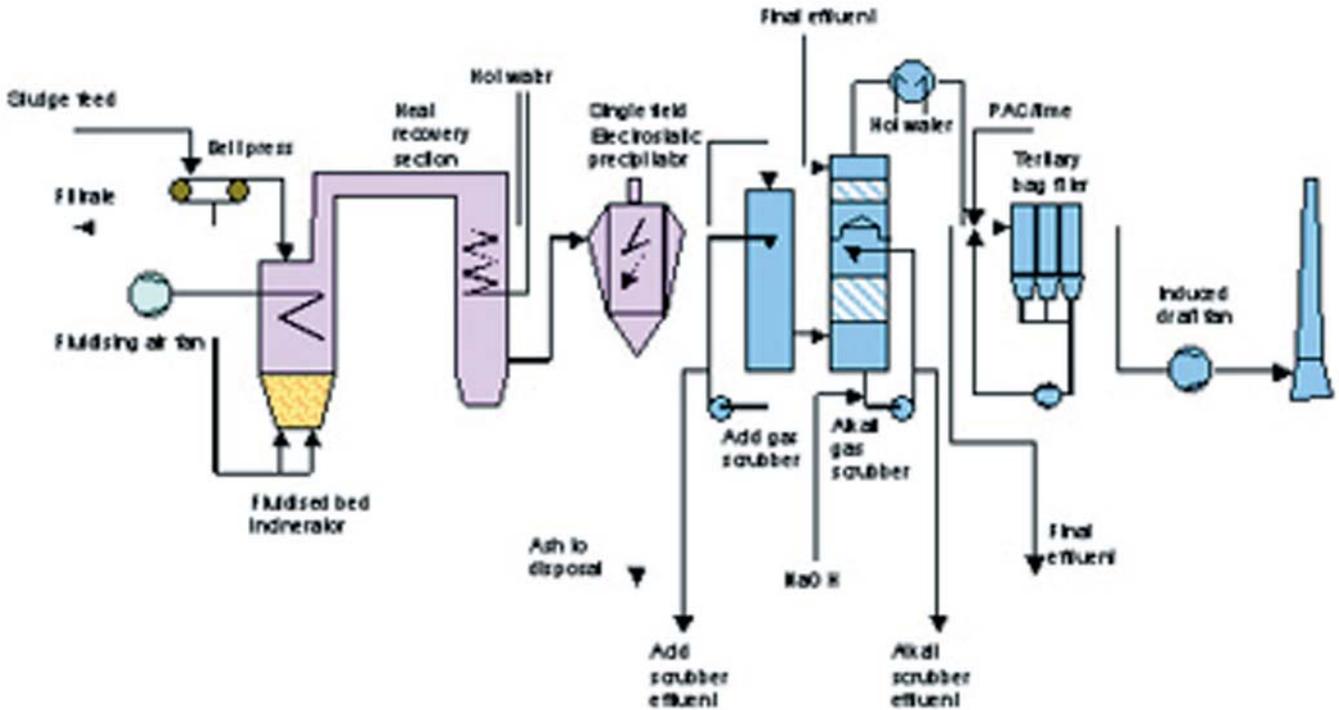
ahead with the design based on option 2, i.e. to modify/replace the wet scrubbing system and to add on a tertiary adsorption stage, in the form of a recirculating bag filter, designed for mercury/dioxin removal.

Project team

In 2002 TEAM, the name of one of Yorkshire Water's Framework Consulting Partners, comprising *MWH, Arup and EC Harris*, were appointed by Yorkshire Water Services to manage the development and implementation of the WID scheme. *Earthtec Morrison (ETM)* were appointed by YWS in July 2003 to undertake detailed design and construction of the scheme.

Detailed design

The upgrade at **Calder Valley, Blackburn Meadows and Esholt** includes new wet scrubbers for removal of the acid gases (hydrogen fluoride, hydrogen chloride and sulphur dioxide) and heavy metals from the flue gas. A flue gas re-heating system then raises the flue gas temperature prior to entering a fabric filter system. Upstream of the fabric filter is an entrained flow reactor where hydrated lime and powdered activated carbon is dosed into the flue gas stream in order to polish the flue gas of any remaining acid gases and heavy metals. The fabric filter then captures any residual particulates in the flue gas and the dosed reagents before the cleaned flue gases are



AFTER UPGRADE

courtesy Yorkshire Water

discharged to atmosphere. *ETM* are working in conjunction with the specialist German process contractor *BAMAG* on these flue gas treatment plant improvements. The minor modifications to the Knostrop facility include a conversion of the existing once-through mode wet scrubbers to a recirculation based system to improve plant performance and to allow configuration with a new scrubber effluent treatment plant.

ETM are also installing two new *Simon-Hartley* high performance sludge belt presses at **Calder Valley** to improve dewatering. This is being undertaken to reduce the supplementary fuel usage in the incinerator. This gives operational cost savings and also improves energy efficiency of the plant.

A De-NOx trial has been undertaken at **Calder Valley** in conjunction with a de-NOx equipment supplier. The de-NOx system used in the trial was a selective non-catalytic reduction system using urea injection into the freeboard of the incinerator. A decision based upon these trials may lead to the installation of permanent de-NOx equipment at **Calder Valley, Blackburn Meadows and Esholt**.

At each incinerator, a new scrubber effluent treatment plant is being installed. This is necessary to remove the captured heavy metals present in the effluent prior to returning the effluent back to the sewage treatment plant. This plant prevents the recycling of heavy metals like mercury between the incinerator and the sewage treatment plant. The scrubber effluent treatment plant process design and mechanical and electrical equipment supply is being carried out by *ACWa Services Ltd*. Each scrubber effluent treatment plant is based upon effluent storage and buffering, neutralisation, metals precipitation using chemical dosing, filtration and sludge handling.

Construction management

A key constraint for the construction phase was that only one incinerator could be shutdown at any one time. The three sites at **Blackburn Meadows, Calder Valley and Esholt** have, therefore, been programmed to achieve sequential design, construction and commissioning activity. This has given *ETM* the opportunity to phase the works to gain knowledge and experience of the scheme

elements and pass that on to each of the subsequent sites on the programme. The more efficient deployment of personnel is also being achieved where *ETM* is able to move Civil, Mechanical, Electrical teams forward to the next programmed site with little or no learning curve during the mobilisation.

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Incinerator - general site view

courtesy: ETM & Yorkshire Water

Likewise the sequential construction of the four Scrubber Effluent Treatment units will reduce down time in moving and remobilising between sites.

Commissioning will be managed in a similar manner to ensure that the lessons learned from earlier sites are taken forward to the later sites. A Joint Commissioning Team, comprising YWS, TEAM and ETM, has been set up for the duration of the project to facilitate the learning exercise, to capture information and to assist in the management of the commissioning phase lessons. Objective of the JCT is to ensure that all project team partners are involved in the efficient delivery of the scheme with minimum down time and disruption to the commissioning periods.

Construction progress

Current progress is summarised below:

*enabling works and trial holing of existing services commenced at Blackburn Meadows site in Sept '03 with the site establishment following approximately 2 months later. Piling of the various structures was achieved ahead of programme in early December '03. In January '04 the sub structure and slab to the Flue Gas Treatment (FGT) unit was constructed followed by civil works to the Scrubber Effluent Treatment (SET) and MCC units. Structural steelwork has been installed during April '04 and the FGT process vessels arrived on site at the end of April.

* **Calder Valley** site was mobilised to start the enabling works and trial holing approximately one month later than Blackburn Meadows site. Here a significant number of services needed diverting away from the location of the proposed FGT unit. This involved working very closely with YWS Operations Staff on site to ensure



Bag Filter

courtesy: ETM & Yorkshire Water

that this work did not interrupt the operation of the incinerator. In addition, the existing sludge thickening tank had to be relocated prior to demolition of the existing tank. As at April '04 all this work has been complete along with piling for the new FGT unit. Work is ongoing to the foundations to the FGT unit in preparation for structural steelwork along with the arrival of the process vessels;

* at **Esholt and Knostrop** sites civil work was expected to start during May/June '04. ■

Note on the authors: Justin Abbott is, TEAM Project Manager; Ken Jones, ETM Project Manager and Steve Wright, ETM Deputy Project Manager.